United States District Court
Northern District of New York

Amy DeMar, Individually and as Administratrix of the Estate of Paul J. Sirianni and Administratrix of the Estate of Gloria M. Sirianni,

Plaintiff,

vs.

D.L. Peterson Trust,

Defendant.

05-CV-0103TJM/RFT

AFFIDAVIT OF DAVID L. GUSHUE

I, David L. Gushue, Ph.D., being duly sworn depose and state:

1. I am employed as a Biomedical Engineer for an engineering firm known as ARCCA, Inc., where I evaluate the mechanisms of injury to the human body during impacts, including automobile crashes. I obtained a Doctor of Philosophy degree in Biomedical Engineering from the University of Rochester, a Master of Science degree from the University of Rochester, and a Bachelor of Science degree in Bioengineering from Syracuse University. I am also a member of the Society of Automotive Engineers, Association for the Advancement of Automotive Medicine, and the Biomedical Engineering Society. While at Rochester, I taught courses to both undergraduate and graduate students related to Biomedical Engineering and Orthopaedic Biomechanics. While at ARCCA, I continue to conduct technical lectures dealing with the causation and prevention of injury trauma during automotive and vehicular crashes. In addition, I have conducted research regarding the injury potential to humans when subjected to the forces of a vehicular collision.

2. I have designed, developed, and tested models of the human body in order to assess the origin and cause of specific injuries and their mechanisms. In addition, I have performed both clinical and experimental kinematic and kinetic studies of the human body. My testing and research have been performed with both anthropomorphic test devices and human subjects. I have conducted these tests using occupants restrained in automotive seating and seat belts and various crash orientations including rollover. As such, I am very familiar with the theory and application of human tolerance to inertial and impact loading, as well as the techniques and processes for evaluating motion of the human body within a crash environment and the scientifically accepted techniques used to assess the potential for injury during a particular collision.

3. I have also worked on a program with the National Institute for Occupation Safety and Health (NIOSH) to research, develop, simulate, evaluate and ultimately test occupant crash protection systems for the rear occupants of ambulances. A specific emphasis was placed on determining under what crash circumstances occupants in the rear of an ambulance can be injured, and the methods and techniques to prevent such injuries.

4. A copy of my current curriculum vitae is attached as Exhibit A.

5. This affidavit is made in response to the report issued by Thomas P. Lacek, P.E., in formulating his opinions regarding the above-captioned matter. Specifically, the scope of my efforts was limited to the evaluation of the methodology, or lack thereof, employed by Mr. Lacek in the formulation of his opinions as reported in his initial report dated February 10, 2006, affirmed at his deposition dated May 17, 2006, and his supplemental report dated June 16, 2006.

6. Mr. Thomas Lacek's opinions stated in his reports are as follows:
   - Paul Sirianni was seated in the left rear, behind the driver. Gloria Sirianni was seated in the right rear, behind the front seat passenger.
   - Paul and Gloria Sirianni were not wearing their seat belts.
   - Paul and Gloria Sirianni received their fatal injuries as a direct result of not wearing their seat belts.
   - Had Paul and Gloria Sirianni been wearing their seat belts, they would not have died as a result of the crash.
   - Had Paul and Gloria Sirianni been using their seat belts, their injuries would have at worst been of the same magnitude as those sustained by Amy and Randy DeMar.

7. Mr. Thomas Lacek's reports outline his analyses related to occupant kinematics, seatbelt usage and biomechanics.
   - *Occupant Kinematics* – Mr. Lacek indicated that he applied the laws of physics to occupants in vehicle rollovers in a general sense stating that, "…in the case of a lateral roll (side to side), ejection will be through the side openings or potential openings, such as windows and/or doors (if the doors open during the crash)."

   - *Seatbelt Usage* – Mr. Lacek concluded that Paul and Gloria Sirianni were not wearing their seat belts when the crash occurred.

   - *Biomechanics* – Mr. Lacek assesses the probability of death by evaluating the AIS (Abbreviated Injury Score) and contrasts the AIS scores of Gloria and Paul Sirianni to that of Amy DeMar, the surviving right-front seated occupant. In his biomechanical analysis, Mr. Lacek himself assigns the AIS score for each injury.

8. In order for an engineer or scientist to proffer the opinions noted by Mr. Lacek, to a reasonable degree of engineering certainty, one must study the specific crash and determine what actually happened to the occupants in question, with consideration for the techniques and methodologies described in peer-reviewed literature. In this specific crash Mr. Lacek attempted to perform this analysis, but failed to apply the scientific method. In order to arrive at his conclusions, at a minimum, he was required to assess the following fundamental questions:

   - Was the crash survivable? Mr. Lacek failed to use a scientific approach to determine the answer to this fundamental question for rear seat occupants in the subject rollover incident. He attempted to directly compare the front seat occupant injuries during the subject rollover to the likelihood of injury to rear seat occupants had their seat belts been in use, without consideration for potential injury mechanisms in that seating location.

- Were the occupants wearing the available restraint system?
- Was the lack of use of the restraint system proximate to the injury? Mr. Lacek fails to address the specific mechanisms of injury for the rear seat occupants in the subject rollover event. In addition, he failed to identify other possible injury mechanisms present to a belted rear seat occupant during this rollover event. Instead he compares what injuries he believes the rear occupants would have sustained based on the performance of the front seat occupants. Although this approach may appear to be scientific, this analysis fails to account for potential differences in the subject vehicle's seat belts from front to rear, differences in roof clearance from front to rear, as well as differences in occupant size. Without taking such information into consideration his answer would constitute nothing more than a guess. Furthermore, he fails to evaluate the injuries of the rear seat occupants to determine in a scientific manner whether or not these injuries occurred inside or outside the vehicle
- Would use of the restraint system eliminate or mitigate the mechanism of serious injury? As mentioned above, Mr. Lacek completely failed to use appropriate scientific methodology for assessing potential injury mechanisms to a belted rear seat occupant in this rollover event.

9. In conducting an analysis for this mishap, at a minimum, an engineer or scientist must assess the nature and severity of the subject incident, seatbelt use or lack thereof, occupant kinematics, injuries sustained, and finally the performance of the occupant protection system in the subject vehicle. The results of this analysis will determine whether the injuries sustained by the rear seat occupant during this crash were preventable with the use of the available restraint system.

10. The performance of an occupant protection system in this rollover incident depends upon a number of factors. The degree of structural intrusion surrounding the occupant space needs to be carefully quantified. Occupant anthropometry (size) as it relates to the fit of the available seat belt system in the vehicle is critically important. The restraint system must remain coupled to the strong parts of the body in order to be effective during rollover events. The following list below identifies a few of the important design criteria as they relate to the ability of a restraint system to provide injury mitigation in a rollover crash. Mr. Lacek failed to properly describe his consideration and evaluation, or lack thereof of the following factors.

    - Accident reconstruction
    - Restraint system geometry: the front seat of this vehicle and the rear seat may have different seat belt configurations due to differences in attachment anchorage locations. These potential geometric differences can significantly effect how a belted occupant moves with in a given crash.[1]
    - Centerline-to-junction length[2]
    - Lap belt anchor geometry and asymmetry[3,4]

---

1 Markushewski, M., et al, "*Assessment of Asymmetrical Anchor Points and Load Limiting Loops with Lap Portion of Automotive Restraints*", ARCCA Incorporated, 35th Annual Symposium, Survival and Flight Equipment, (SAFE), Sept 8-10, 1997, Phoenix, AZ

2 Federal Motor Vehicle Safety Standard 208.

3 Markushewski, M., et al, "*Assessment of Asymmetrical Anchor Points and Load Limiting Loops with Lap Portion of Automotive Restraints*", ARCCA Incorporated, 35th Annual Symposium, Survival and Flight Equipment, (SAFE), Sept 8-10, 1997, Phoenix, AZ

4 Federal Motor Vehicle Safety Standard 210.

- Shoulder belt D-ring location[5]
- Retractor type and lockup performance[6]
- Seat belt latchplate type[7]
- ELR/ALR issues[8]
- Buckle design[9]
- Seat and seat back design and strength[10]
- FMVSS, NCAP and IIHS crash performance

Scientific methodology then dictates that, at a minimum, each of these factors and their associated interactions need to be evaluated in the context of an injury(or injuries) to arrive at a conclusion to a reasonable degree of engineering certainty. An example illustrating the interaction of several factors is that a properly belted outboard occupant in a rollover incident involving a vehicle with significant lateral roof crush may be exposed to external ground contacts by the head and upper torso and as such be seriously injured or killed while wearing the seat belt. Mr. Lacek failed to conduct this type of analysis, or even consider the peer-reviewed scientific literature dealing with occupant restraint performance in rollover events.[11,12,13] Mr. Lacek failed to reference or acknowledge approaches typically used in mainstream science for evaluation of what a belt can, or cannot, do for someone in a rollover. Without basing his opinions on accepted science, Mr. Lacek's opinions and conclusions lack basis and scientific foundation

11. The biomedical engineering community uses a number of accepted standard analysis techniques and methodologies for evaluating the performance of an occupant protection system during rollover events.[14,15,16,17,18] Not all are required for any given mishap, however, Mr. Lacek failed to conduct any of these. These analyses evaluate the potential for injury by studying occupant kinematics during static, quasi-static and dynamic conditions to determine potential contact areas within the vehicle. If compromise of the

---

5 Federal Motor Vehicle Safety Standard 210.

6 Federal Motor Vehicle Safety Standard 209.

7 Federal Motor Vehicle Safety Standard 209.

8 Federal Motor Vehicle Safety Standard 209.

9 Federal Motor Vehicle Safety Standard 209.

10 Federal Motor Vehicle Safety Standard 207.

11 Orlowski, K, Bundorf, R. T., and Moffatt, E. (1985). Rollover Crash Tests-The Influence of Roof Strength on Injury Mechanics (SAE 851734). Warrendale, PA, Society of Automotive Engineers.

12 Bahling, G.S. et al Rollover and Drop Tests – the Influence of Roof Strength on Injury Mechanics using Belted Dummies. (SAE 902314). Warrendale, PA, Society of Automotive Engineers.

13 Benda, B. J., L. D'Aulerio, et al. (2006). Performance of Automotive Seat Belts During Inverted (-Gz) Rollover Drop Tests. Icrash 2006--International Crashworthiness Conference, Athens, Greece, University of Bolton.

14 ARCCA, Inc, *Occupant Crash Protection Handbook for Tactical Ground Vehicles* (2000).

15 Vital and Health Statistics, Data from the National Health Survey (1965). *Weight, Height, and Selected Body Dimensions of Adults, United States, 1960-1962.*

16 Pywell, J., Rouhana, S., McCleary, D., DeSaele, K. (1997). Characterization of Belt Restraint Systems in Quasistatic Vehicle Rollover Tests (SAE 973334). Warrendale, PA, Society of Automotive Engineers.

17 Nahum, A.M. and Gomez, M.A. (1994). Injury reconstruction: the biomechanical analysis of accidental injury. Tests (SAE 940568). Warrendale, PA, Society of Automotive Engineers.

18 Benda, B. J., L. D'Aulerio, et al. (2006). Performance of Automotive Seat Belts During Inverted (-Gz) Rollover Drop Tests. Icrash 2006--International Crashworthiness Conference, Athens, Greece, University of Bolton.

structure occurs, then possible ground contact is also evaluated during testing. Some accepted techniques for this evaluation are discussed below.

1. Surrogate Fit Check Analysis: This analysis method can be either empirical or analytical in nature. The empirical approach would use a surrogate, or multiple surrogates and place them into an exemplar or the actual vehicle if available. Occupant clearance measurements to determine potential for head, upper torso and body contact are taken with the surrogate(s) in the belted and unbelted condition. This study will also determine available ride-down space within an undamaged exemplar vehicle and compare them to the actual crash vehicle. The results of this evaluation are critical to determine injury potential within the vehicle for seat belted occupants.

2. Vehicle with Live Subject Occupant Inversion Test: An exemplar vehicle matching the actual crash vehicle is mounted into an inversion fixture. Surrogate human test subjects are then placed into the fixture and restrained using the available seat belts in the vehicle. The test fixture is then rotated and occupant motion is quantified under inverted conditions. The test fixture permits evaluation and precise measurement of live subjects under 1g conditions and is then compared to dynamic test data.[19] The results of this analysis will determine potential mechanism of injury to a belted occupant in a rollover event such as the subject incident. [20,21] I have tested a variety of restraint systems in this fixture using dummies as well as live volunteer human test subjects. This evaluation approach has been published in peer-reviewed journals and learned treatises.[22] It is a well established scientific methodology for evaluating restraint system performance. I have routinely used this method for evaluating occupant motion with various restraint system designs for automotive applications. This type of study is generally accepted in the scientific community, and the results are repeatable and reliable. Mr. Lacek failed to conduct such an analysis for this mishap.

3. Dynamic Rollover Testing: Full scale rollover studies with ATDs[23] are often conducted[24] and are part of the Federal Standards for evaluation of the performance of roof structure as well as the design and performance of the available restraint system. The primary injurious event during the rollover of the subject vehicle occurs when the roof of the vehicle impacts the ground. Even properly restrained occupants can impact the roof or the ground if there is structural compromise. It is clear that the subject vehicle sustained structural collapse of the roof over at least part of the rear seat occupant space.

4. One of the fundamental requirements of an occupant protection system is the preservation of space surrounding the occupant within the vehicle. It is this space

---

19 Schulman, M., Critz, G., Highly, F., Hendler, E. (1963). Determination of Human Tolerance to Negative Impact Acceleration.

20 Pywell, J., Rouhana, S., McCleary, D., DeSaele, K. (1997). Characterization of Belt Restraint Systems in Quasistatic Vehicle Rollover Tests (SAE 973334). Warrendale, PA, Society of Automotive Engineers.

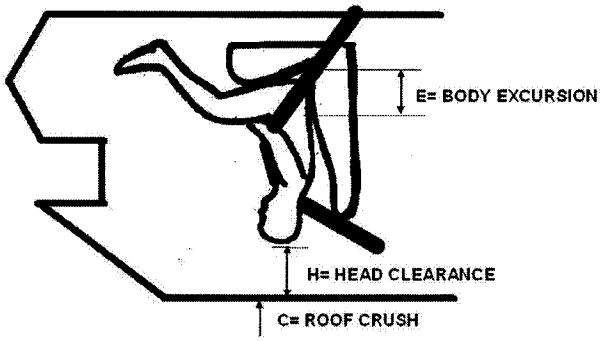
21 Schulman, M., Critz, G., Highly, F., Hendler, E. (1963). Determination of Human Tolerance to Negative Impact Acceleration.

22 US Army (2000). *Occupant Crash Protection Handbook for Tactical Ground Vehicles.*

23 Anthropomorphic Test Device, , i.e. test dummy

24 Federal Motor Vehicle Safety Standard 208

that the occupant uses to "ride down" the impact force and react that force through his/her restraint system during foreseeable and protectable crashes.[25,26,27,28] When that space is compromised, as it was in this crash, the occupant can receive impact injuries from intruding structure. Rollover crash events not only involve vertical accelerations but also may include frontal and lateral accelerations. [29,30] In general, the most critical parameters that control occupant motion during rollover are shown in below figure:



H > C + E

For No Head-to-Roof Contact

Figure 1 - Rollover Schematic

H= initial clearance between head and roof

E= vertical excursion during the rollover

and

C= roof deformation or crush during the rollover

Clearly, in order to avoid potentially injurious head-to-roof impacts one must have;

$$H > C + E$$

In simple terms, the initial head clearance must be greater than the sum total of the roof deformation and occupant vertical excursion if head and upper torso impacts with the roof are to be avoided.

12. Mr. Lacek's conclusions are flawed for the following reasons:

- Mr. Lacek did not perform an adequate evaluation of the occupant protection system in the rear of the subject vehicle to determine how it would perform in a rollover.

---

25 Chandler, R. (1985). *Restraint System Basics*.

26 US Army (2000). *Occupant Crash Protection Handbook for Tactical Ground Vehicles*

27 Eppinger, R. (2002). Chapter 8: Occupant Restraint Systems. Accidental Injury – Biomechanics and Prevention. New York, Springer-Veriag.

28 Eiband, M. A. (1959). *Human Tolerance To Rapidly Applied Accelerations: A Summary of the Literature.* NASA.

29 Halliday, D., Resnick, R., Walker, J. (1993). Fundamentals of Physics. New York, John Wiley & Sons.

30 Sicher, L., et. al. (2001). *Lateral Restraint: Comparison of Lap/Shoulder Belt vs. Lap/Shoulder Plus Supplemental Shoulder Belt Restraint Systems.* SAFE Proceedings September 17-19, 2001

- Mr. Lacek failed to quantify the degree of structural intrusion into the occupant space and the potential for impact with intruding structure to a rear seated occupant during this rollover event.
- Mr. Lacek did not conduct a surrogate fit check analysis to assess either the static or dynamic head clearance for either of the rear-seated occupants.
- Mr. Lacek failed to consider a restrained occupant's head or upper torso moving out of the window during a rollover event due to lateral roof crush evident on this vehicle. .
- Mr. Lacek failed to properly analyze the potential mechanism of injury for rear seat belted occupants in this vehicle during a rollover event.
- Mr. Lacek did not assess or quantify the magnitude of occupant excursion afforded by the available restraint system during a rollover event.
- Mr. Lacek failed to conduct any testing whatsoever, either empirically or analytically, to determine the survivable nature of this crash.
- Without such evaluations, Mr. Lacek is unable to conclude to a reasonable degree of engineering certainty that wearing the available seat belt would have eliminated or mitigated the sustained injury(s).

13. Due to the lack of analysis conducted by Mr. Lacek, several of his opinions are unsupported:

- Mr. Lacek's biomechanical analysis includes an isolated occupant injury comparison analysis between both Paul and Gloria Sirianni and the right front occupant, Amy DeMar. Yet, he does not account for any differences in their sizes and pre crash clearances. A proper analysis of the subject rollover event must include an occupant injury comparison analysis that considers differences in the occupant's anthropometry, available occupant ride-down space, and the performance of the subject seat belt. Without consideration of these factors, Mr. Lacek is unable to conclude to a reasonable degree of engineering certainty that both Paul and Gloria Sirianni, "would not have died," if they were wearing their respective available seat belts.

- Mr. Lacek's conclusion regarding head contact based upon his forensic examination is inconclusive. Mr. Lacek concluded, "that no hard interior contact occurred by either Paul or Gloria Sirianni prior to their ejection that would have caused their injuries." Mr. Lacek's basis for this conclusion appears to be his observation that the headliner of the subject vehicle was not permanently compressed over the rear-seated occupant positions, as well as the forensic discovery of hair within the headliner of similar color to both Paul and Gloria Sirianni. To make such a conclusion would require a detailed inspection of the interior structures of the subject vehicle for body impact marks, as well as the removal of the headliner for a detailed inspection of the actual roof structure. Mr. Lacek does not indicate he performed any of these investigations. The absence of forensic evidence in this regard does not rule out injurious contacts.

- In Mr. Lacek's supplemental report, he opines that, "Paul and Gloria Sirianni received their fatal injuries as a direct result of not wearing their seat belts." Yet he provides no basis for this opinion. Such an opinion requires a biomedical engineering evaluation that specifically addresses what the injuries were, and how the use of a seat belt would have prevented them in relation to occupant kinematics in the subject incident.

- Mr. Lacek is unable to form an opinion to a reasonable degree of engineering certainty, given his lack of a detailed investigation into the effects of structural intrusion into the occupant space, and the design and performance of the available restraint system on the kinematics of the subject occupants in the subject rollover event,.

I declare under penalty of perjury that the above is true and correct.

David L. Gushue, PhD

ACKNOWLEDGEMENT

STATE OF PA)
) ss.
COUNTY OF Bucks)

On this 7th day of August, 2006, before me appeared David L. Gushue, PhD, to me known to be the person described in the foregoing instrument and who acknowledged that he executed said instrument as his free act and deed.

IN WITNESS WHEREOF, I have hereunto subscribed my name and affixed my official seal the day and year last above written.

Susan C. Baldino
Notary Public

My Commission Expires:

Commonwealth of Pennsylvania
NOTARIAL SEAL
SUSAN C. BALDINO, NOTARY PUBLIC
WRIGHTSTOWN TOWNSHIP, COUNTY OF BUCKS
MY COMMISSION EXPIRES JUNE 24, 2010